Deep UV Raman/Fluorescence (DUV-RF) Stand-off sensor for Lunar Science, Phase I

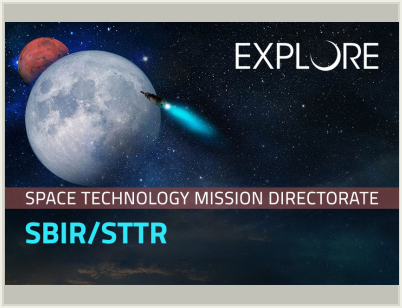
Completed Technology Project (2009 - 2009)

Project Introduction

This proposal enables development a miniature, low power consumption, fused deep UV Raman and native fluorescence (DUV-RF) stand-off sensor. The proposed fused instrument has the ability to measure the spatial distribution of chemical species containing C, N, H, O, S, Cl, and/or water, ice, and hydrated minerals on a 1-5 mm spatial scale enabled by a novel set of wide aperture, high sensitivity ultraminiature deep UV Raman spectrometers. Raman spectroscopy is a non-contact, non-destructive, method of identifying unknown materials without the need for sample acquisition and processing. This technique is ideal for in situ exploration from extraterrestrial Rovers or landers. There are three main advantages of deep UV Raman methods over near-UV, visible or near-IR counterparts. 1) Rayleigh-law: signal enhancement of 20x at 248nm compared to excitation at 532nm. 2) Resonance: much higher signal enhancements; for water 5 times greater than Rayleigh-law enhancement alone, for a combined effect over 120x between 248 nm and 532 nm. 3) With excitation below 250nm, Raman scattering bands occur in a fluorescence-free region of the spectrum. At longer excitation wavelengths fluorescence from target or surrounding materials overwhelm Raman emissions and require gating with high power lasers with narrow pulse widths leading to sample alteration/damage. When deep UV Raman is combined with native fluorescence, it becomes possible to characterize mineral alterations and detect trapped chemicals with exquisite sensitivity and differentiability. The New Frontiers has placed a South pole-Aitken Basin sample return as a future mission scenario. Using the enhanced detection capabilities of DUV-RF, water, ice and chemical species can be detected and mapped to provide an understanding of their distribution in the lunar regolith.

Anticipated Benefits

Potential NASA Commercial Applications: The technology being addressed by this proposal is immediately useful for Department of Defense (DOD) and Homeland Security (HS) applications as well as non-government commercial and industrial applications. DOD and HS applications include in situ biological and chemical warfare sensors to detect trace levels of biological, nerve, and blister agents as well as low-volatility toxic industrial chemicals (TICs). The ability of the sensor to measure hazardous materials a meters of working distance vastly improves their use by first responders. In addition, a broad range of non-government commercial and industrial applications are addressed by the proposed sensor including: environmental testing of water, soil and air; municipal and industrial water and waste-water quality testing; commercial product quality control testing of manufactured food, chemical, semiconductor, and other commercial products; and a wide range of research applications enabled by the core technologies developed on this program.



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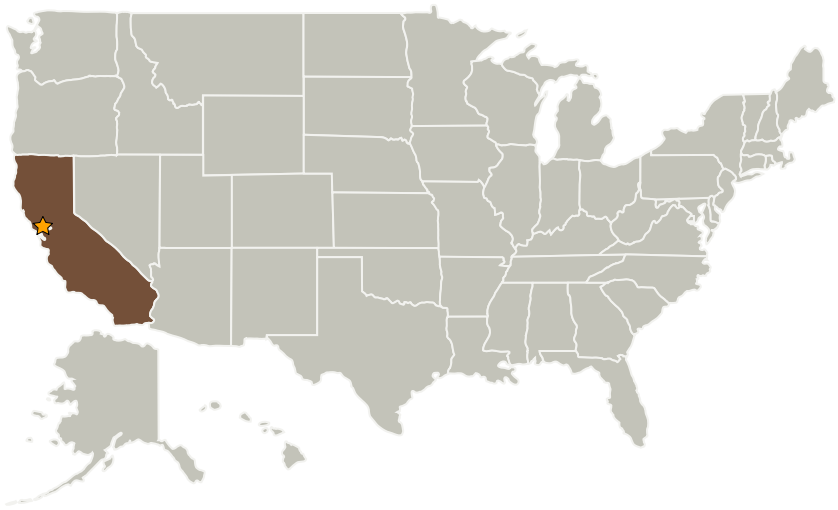
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Ames Research Center(ARC)	Lead Organization	NASA Center	Moffett Field, California
Photon Systems, Inc.	Supporting Organization	Industry	Covina, California

Primary U.S. Work Locations
California

Project Transitions

January 2009: Project Start

July 2009: Closed out

Closeout Summary: Deep UV Raman/Fluorescence (DUV-RF) Stand-off sensor for Lunar Science, Phase I Project Image

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Ames Research Center (ARC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Carol R Stoker

Principal Investigator:

William Hug

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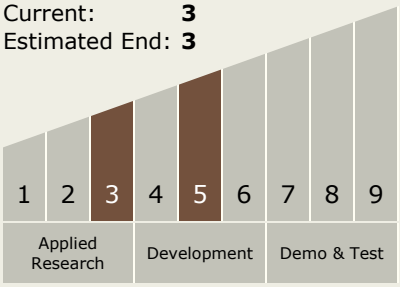
Completed Technology Project (2009 - 2009)

Technology Maturity (TRL)

Start: **5**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.3 Mission Operations and Safety
    - TX07.3.5 Planetary Protection